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Chapter 6

Installation of the pneumoperitoneum; technique and complications

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Abstract

A variety of techniques to establish a pneumoperitoneum have been described. Roughly, techniques for the installation of the pneumoperitoneum can be divided in two groups. The first group comprises of introductions performed without direct visual control, the so-called blind-entry techniques. These blind-entries are performed by using a Veress needle to establish the pneumoperitoneum followed by trocar insertion, or less frequently used, direct trocar insertion without previously establishing a pneumoperitoneum. The other group comprises of entry techniques performed with visual control, including the open-entry technique and the closed-entry techniques with optical trocar devices.

For all the entry techniques there is a wide variety of reusable and disposable trocars, and Veress needles designed and marketed with its individual advantages and disadvantages. With respect to complications, approximately one half of all intra-operative laparoscopic complications are caused during the establishment of the pneumoperitoneum and introduction of the trocars. The reported incidence of vascular and bowel injuries varies and is between 0.05 and 0.5 complication per 100 laparoscopic procedures. In literature, it is suggested that the open-entry technique is the safest introduction technique because an overshoot of the introduction, especially those resulting in retroperitoneal vascular injury, can be avoided. However, an open-entry does not preclude bowel injury. In patients who had no history of abdominal surgery the installation of the pneumoperitoneum by using the reusable TrocDoc® trocar (“half open”) might be an effective and less expensive alternative for the traditional open-entry technique according to Hasson. In obese patients an open-entry technique can be technically difficult. For these patients the blind-entry technique with the Veress needle remains a good alternative. Finally, the identification of patients with an increased risk of an entry-related injury is essential for a safe installation of the pneumoperitoneum to prevent injuries.
Introduction

Several randomised controlled trials and meta-analyses have demonstrated that laparoscopic surgery is superior to conventional open surgery in terms of morbidity, postoperative recovery, and hospital stay.\textsuperscript{1-3} Due to these short term advantages, laparoscopic surgery has achieved broad acceptance nowadays and is a fast expanding surgical discipline. However, the initiation of laparoscopic surgery, i.e. the creation of a pneumoperitoneum and subsequently the introduction of the surgical instrumentation, remains a potentially dangerous first step, which is exclusively associated with the laparoscopic approach. Several studies have demonstrated that 20% to 50% of all intra-operative morbidity during laparoscopic surgery occurs during the installation of the pneumoperitoneum.\textsuperscript{4-6}

Several techniques to establish the pneumoperitoneum have been described. Roughly, entry techniques can be divided in two groups (Table 1). The first group comprises of introductions performed without (direct) visual control, the so-called blind-entry techniques, which are performed by using a Veress needle to establish the pneumoperitoneum followed by primary trocar insertion or, less frequently used, direct trocar insertion without previously establishing a pneumoperitoneum. The other group comprises of entry techniques which are performed with visual control. This group includes the open-entry technique and the closed-entry techniques with optical trocar devices. The open-entry technique is performed through a small laparotomy. Successively, skin, rectus fascia, and peritoneum are incised under direct vision, followed by blunt (Hasson’s) trocar insertion. Subsequently, the pneumoperitoneum is created. This technique was firstly described by the gynaecologist Harrith Hasson in 1971.\textsuperscript{7} Alternative techniques for the open placement technique are closed-entry techniques with optical trocar devices. The transparent tip of the optical trocar allows a controlled passage of the individual tissue layers of the abdominal wall.\textsuperscript{8}

Table 1. Overview of entry techniques

<table>
<thead>
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<th>Visually controlled entry techniques</th>
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<tr>
<td>1. Open-laparoscopy</td>
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<td>2. Closed-entry techniques</td>
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<th>Blind-entry techniques</th>
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<td>1. Direct trocar insertion</td>
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<td>2. Veress needle</td>
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<td>- normal pressure (12-15 mmHg)</td>
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<td>- high pressure (25-30 mmHg)</td>
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<td>- optical Veress needle</td>
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With respect to the prevention of entry-related injuries none of the above mentioned techniques is supported by solid evidence and until today there is an ongoing debate, mainly between gynaecologists favouring the closed-entry technique, and surgeons favouring the open-entry technique, which technique is to be preferred.\textsuperscript{6,9} Many general surgeons suggest that the open-entry technique results in an equal amount of visceral lesions compared to the closed-entry technique, but significantly fewer (retroperitoneal) vascular lesions.\textsuperscript{5,9}

In this chapter several techniques for the establishment of the pneumoperitoneum are described including the instrumentation that is used and the potential complications that can occur.

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**Instrumentation**

**The Veress needle**

The pneumonologist Janos Veress introduced a needle for the establishment of a pneumoperitoneum in 1938. This so-called Veress needle has two working parts; an outer needle with a sharp bevelled edge, and an inner, spring-loaded, retractable blunt shaft that extends beyond the end of the needle point. During insertion, the blunt inner part of the needle is pushed inwards resulting in a sharp tipped instrument. As soon as the peritoneum is penetrated, the blunt shaft is propelled forward beyond the sharp tip by the spring-loaded mechanism, thus making the instrument blunt. Theoretically, this mechanism prevents that the sharp tip of the needle reaches the intra-abdominal organs and blood vessels.

Standard lengths of the Veress needle are 10, 12, and 15 centimetres. Veress needles are available in both disposable and reusable systems. Besides the standard Veress needle, optical needles are also available. The outer shaft of the optical Veress needle has a diameter of 2.1 millimetres and a length of 10.5 centimetres. After correct placement of the needle a mini-laparoscope with a diameter of 1.2 millimetre is introduced though the outer shaft. The optical Veress needle can be used in patients with an increased risk of peri-umbilical adhesions. The optical system offers an intra-abdominal visual control during the placement of the primary trocar. A panoramic view on the abdominal cavity and subsequent visualisation of adhesions around the umbilical area can be established after placement of the optical Veress needle at Palmer’s point (left upper quadrant). When adhesions are absent the primary trocar can still be placed at the umbilicus.

**Trocars**

Trocars are an essential part of the laparoscopic instrumentation. The word “trocar” is originated from the French word “trois quarts”, which is the original name for a knife with three cutting edges. All trocars share the common aim of allowing the passage of surgical instruments into the peritoneal cavity, whilst simultaneously preventing gas leakage. The latter is in general by means of a flapper-valve or rubber membrane mechanism. A wide
variety of reusable and disposable trocars have been designed and marketed for the use of laparoscopic surgery.

Disposable trocars are constructed predominantly of plastic materials. Many disposable trocars have a built-in mechanism guarding their sharp tips, these are the so-called shielded trocars. They usually rely on one of three basic designs; either a retractable external shield, a retractable central blunt point, or an internal shield which protects the sharp outer sleeve of the trocar. The shields are either retracted prior to placement of the trocar in the wound or automatically retract during the placement. Once the sharp tip of the trocar penetrates the abdominal wall and enters the abdominal cavity, the spring-loaded safety shield automatically deploys, covering the cutting edges of the tip and locking in place. Both the retractable spike and the internal shield may provide more effective protection than the external shields, which can be retracted during the passage of the abdominal wall by the surrounding tissues. Also, most reusable trocars do not have a guarded design.

When assessing the costs per instrument used, disposables initially appear more expensive due to the obvious higher purchase price. However, cleaning and sterilisation costs for reusable trocars must also be taken into account.

In general, reusable trocars are less sharp compared to disposable trocars. Therefore, during the insertion of a sharper disposable trocar less force is required. When performing a blind-entry technique using the Veress needle, it might be advantageous to use a sharper disposable trocar because “overshoot” of the introduction might be prevented due to the fact that less force is required during insertion.

Besides threaded cannulas that do not require a trocar for entry and optical trocars, trocars are created with a tip based on several designs including blunt, conical, round, bladed, and pyramidal tipped trocars. Blunt trocars, such as the widely known Hasson trocar, are used during the open-entry technique. Conical trocars, however, have a round sharp tip and dilate the fascial and muscular tissue after a small opening is made. Each side of pyramidal trocars forms a knife-like surface that slices open the tissue encountered. Less force is used during the insertion of these pyramidal trocars as compared to conical trocars.

Optical trocar systems allow for placement of the laparoscope in the trocar during the insertion, enabling the operating surgeon to continuously visualise the layers of the abdominal wall throughout the insertion process.

**Entry techniques**

The patient is positioned supine on the table, without rotation or a head down or modified Trendelenburg position. Because in these alternative positions, the relationships of the great vessels and other gastro-intestinal structures to the abdominal landmarks such as the umbilicus may be altered increasing the likelihood of injury. Verification of the position of several important anatomical structures is vital. Localising the aortic bifurcation,
palpation of the promontorium and crista iliaca provide a contribution to the virtual image of the abdominal cavity. Furthermore, organomegaly or intra-abdominal tumours should be ruled out via palpation or percussion. An empty bladder is important to avoid bladder injury and to provide more range of vision and working space. Bladder drainage can be achieved by inserting a urine catheter or once-only catheterisation. A nasogastric tube prevents gastric distension which reduces the risk of injury to the stomach and transverse colon. Drainage of the bladder and stomach are especially important when performing a blind-entry technique. Finally, the instrumentation to perform a laparotomy should be close at hand in case of serious vascular injury caused by the introduction of the Veress needle or trocar.

The open-entry technique

During the open-entry technique according to Hasson, a small laparotomy is performed of 1-2.5 centimetres. Successively, skin, rectus fascia, and peritoneum are incised under direct vision, followed by the insertion of a blunt trocar (Hasson trocar). During the incision of the several layers, the abdominal wall should be lifted, for example with towel clips or clamps. The introduction of the primary trocar is performed completely under direct visual control. After the blunt trocar is inserted and its correct position is confirmed, the gas insufflation can be initiated directly through the cannula with the obturator (inner removable part) still in place. After the pneumoperitoneum has been established, the trocar is fixated with two sutures. Modified Hasson trocars are manufactured with an inflatable balloon for a gas tight fixation of the trocar. At the termination of the laparoscopic procedure the trocar is removed with the laparoscope in it, followed by fascial closure. With the exception of the blunt primary trocar and the instruments necessary for the mini-laparotomy, the remaining instrumentation is identical to the other entry techniques. It is assumed that the open-entry technique reduces retroperitoneal vascular injuries to a minimum. However, the open-entry technique is less frequently used as compared to the blind-entry technique with the Veress needle. Reasons for this are the assumed larger incision (scar) that has to be made with the open-entry technique and the fact that more manipulations are needed with the open-introduction technique. Furthermore, the occurrence of gas leakage at the primary trocar site might be higher with the open-entry technique. Nevertheless, several studies have demonstrated that the open-entry technique is faster and cheaper as compared to entries with the Veress needle.

Besides the traditional Hasson trocar, several disposable and reusable blunt trocars have been designed and marketed. One of these is the blunt TrocDoc® trocar which was derived from a sharp tipped trocar. The tip of a 10/11-mm trocar was loosened from it shaft and replaced by a longer blunt tip, which was 10 mm at the connection with the shaft tapering to 5 mm at the tip. The peritoneal cavity is reached through an incision large enough to facilitate the passage of the 5-mm blunt tip of the TrocDoc®. Due to the gradual increase in diameter from 5 to 10 mm, the trocar can be pushed in gently by stretching the abdominal fascia, providing a tight fit without gas leakage. This introduction technique provides visual control and needs no fixing sutures as with the Hasson trocar.
Closed-entry techniques with optical trocar devices

Optical trocars (Optiview®, Visiport®) allow a visually controlled passage of the individual tissue layers of the abdominal wall. The transparent trocar and the laparoscope are inserted together. The layers of the abdominal wall can be visualised individually, at which the peritoneal cavity depicts dark. In contrast, adhesive bowel and omentum depicts more lighter. Furthermore, in the event of an injury it can be noticed directly.

Another instrument that allows a visually controlled insertion, is the so-called endoscopic screw (Endotip®). The insertion of the endoscopic screw is performed without a prior pneumoperitoneum. After a small incision is made in the fascia the endoscopic screw, with the laparoscope in it, is ‘screwed’ in the fascia with a rotary motion. During the insertion the tissue is pushed away instead of being devided.13;16 It must be stressed that the recognition of the successive layers of the abdominal wall is not easy applying these closed-entries using optical trocar devices.

Blind-entry technique with the Veress needle

Before using the Veress needle, the sharpness and the spring-loaded tip mechanism must always be checked if it functions properly. Subsequently, after a small incision is made and the abdominal wall is lifted, the needle is introduced at an angle to the abdominal wall; normally this angle is approximately 30-45 degrees with respect to the vertical axis. The slantwise introduction of the needle is because of the fact that the needle must be introduced perpendicular with respect to the abdomen wall. When the abdomen wall is lifted, an angle is then created with the horizontal axis. Lifting the abdominal wall is mainly for fixation, otherwise the abdomen wall would be pushed inwards and the distance to the retroperitoneal structures would be reduced. It should be noted that the distance between the abdominal wall and the underlying structures is not increased during lifting as long as there is no pneumoperitoneum because the intra-abdominal structures are still situated against the abdomen wall (i.e. intra-abdominal vacuum). When the tip of the needle reaches the abdominal cavity, a double click is heard or felt which is caused by retraction of the blunt inner part of the needle after the penetration of the fascia and peritoneum. Furthermore, a hissing sound caused by passing air into the peritoneal cavity due to the negative intra-abdominal pressure can be heard. The correct position of the Veress needle can be verified with several tests such as the “drip-test”. The test involves of a drip of NaCl which is placed on top of the closed Veress needle. When the needle is opened the drip of NaCl is sucked into the needle, especially when the abdominal wall is lifted. Another test to confirm proper needle placement is Palmer’s aspiration test. Here, a syringe filled with NaCl is connected to the Veress needle. Next, the NaCl is “injected” intra-abdominally through the Veress needle. The NaCl should be inserted without any resistance. Subsequently, with the same syringe an attempt is made to aspirate and during this manoeuvre the aspiration of blood or bowel contents is abnormal. Other tests include the disappearance of liver dullness during percussion, symmetrical distension of the abdomen during insufflation, and confirmation of the negative intra-abdominal pressure after connection with the insufflator during lifting of the abdominal wall.17 If the correct
position of the needle is verified, insufflation can be performed up to a pressure of 12-15 mmHg. Insufflation of CO₂ gas with a flow of 2-3 l/min with a low counter pressure (< 5 mmHg) also indicates correct position of the needle.

Following the insertion of the needle and insufflation, the primary trocar is inserted at the same place as the needle was positioned. Before the insertion of the primary trocar, it is important to ensure that the skin incision is large enough. Resistance during the insertion of the trocar is in general caused at skin level where the incision is not large enough and not during the passage of the fascia. If the Veress needle can not be placed correctly, another one or two attempts might be undertaken. Thereafter, an open-entry should be performed.

The so-called radial distension trocar (Step®) is made up of a Veress needle with a polymeric sleeve, both are inserted simultaneously. After the correct position of the needle is checked and the abdomen is insufflated, the needle is retracted from the sleeve. Subsequently, the sleeve is dilated with a blunt obturator. With this technique the layers of the abdominal wall are pushed away instead of being perforated or incised. The advantage of this technique is that the needle with the sleeve is the only sharp instrument that is blindly inserted. Furthermore, stability of the trocar, less gas leakage, less tissue damage, less postoperative pain, and a decreased risk of postoperative hernia are reported as advantages as well.

With the hyperinsufflation technique, a higher abdominal pressure is applied during the entry of the first trocar to prevent injury, especially injury of the large retroperitoneal vessels. After the insertion of the Veress needle and confirmation of its correct position a pneumoperitoneum is established with high pressures of 25-30 mmHg. Subsequently, at the umbilical entry site, the primary trocar is inserted. After entrance of the abdominal cavity with the trocar, the intra-abdominal pressure is decreased. The higher intra-abdominal pressure increases the distance between the abdominal wall and the retroperitoneal vessels. Furthermore, the high pressure gives more counter pressure during the insertion of the trocar. The high pressure is maintained only for a short period, therefore the risk of deep venous thrombosis, gas emboli, and subcutaneous emphysema is minimal. This technique is applied mostly in young and healthy patients. In these patients the influence of the high intra-abdominal pressure on the cardiovascular system and pulmonary functions is limited. However, in the elderly and in patients with severe comorbidity the increased intra-abdominal pressure might result in cardiovascular or pulmonary complications. Therefore, this technique is only suitable in young and healthy patients.

**Direct trocar insertion**

Direct insertion of the first trocar without previously establishing a pneumoperitoneum can be applied in a selected group of patients with a mobile ventral abdominal wall and without a history of abdominal surgery or infections. Sufficient muscle relaxation, a skin incision large enough to facilitate the trocar without resistance, sharp trocars, and knowledge of the position of important anatomical structures, such as the aortic bifurcation, are essential when applying this technique. The advantage of this technique
is that injuries caused by the introduction of the Veress needle are avoided. However, the
insertion of the primary trocar is still performed without any visual control and with the
risk of an overshoot of the introduction.

**Secondary trocar placement**

Injury to the epigastric vessels during placement of secondary trocar(s) form a substantial
part of all vascular injuries. The secondary trocar should be placed in a well-controlled
manner and with direct visualisation to prevent injuries. The laparoscope is used to identify
the deep inferior epigastric vessels (typically located underneath the rectus muscles) and
transillumination is used to identify the superficial vessels.

**Entry sites**

The usual site for the primary introduction is the lower border of the umbilicus, where the
abdominal wall is at its thinnest and the skin is in direct contact with the fascia despite the
presence of adiposity. It is important not to damage the intra-abdominal structures during
the incision of the skin and fascia since there are reports of severe vascular injuries made
with a scalpel during the skin incision. When there is a deformity of the umbilicus or when
the risk of intra-abdominal adhesions is increased, an introduction at the umbilicus might
be undesirable. Alternative introduction places include a point halfway the umbilicus and
the pubic symphysis, directly above the umbilicus, left or right at McBurney’s point or
between the seventh and eight costa in the midaxillary line on the left side. Another
alternative, specially when adhesions at the umbilicus are expected or with bariatric
surgery, is Palmer’s point, which is located three centimetres caudal of the lowest costa in
the mid-clavicular line on the left.

**Removal of the trocars**

Removal of the trocars should be performed under direct visual control. The last trocar is
removed with the laparoscope in the trocar. This allows identification of vascular injuries
which remained unnoticed because the bleeding was temporarily stopped due to the
pressure of the pneumoperitoneum or plugging by the trocar. Furthermore, bowel injury
and the occurrence of herniation can also be identified during the trocar removal.
Fascial defects created by 10-mm or larger trocars should be closed to prevent hernia
formation. All layers of the abdominal wall should be closed meticulously under direct
vision including the peritoneum. When active manipulation through a 5-mm port has
occurred during prolonged procedures or stretching the port side for retrieval, the fascia
should also be closed to prevent complications.
Complications

It has been calculated that approximately one half of all intra-operative laparoscopic complications is caused during the installation of the pneumoperitoneum and the subsequent introduction of the trocars.\textsuperscript{4,6,27} Entry related injuries can be divided in two different groups. The first group comprises of injuries to blood vessels and organs within their normal anatomical position. The second group comprises of injuries to structures which are located at an abnormal position, such as bowel or omentum which is adhesive to the anterior abdominal wall. Besides direct injury to intra-abdominal structures during the entry phase, the pneumoperitoneum itself influences the cardiovascular system due to the increased intra-abdominal pressure. The cardiovascular effects of the pneumoperitoneum occur mainly during its initiation. This should be considered when the intra-abdominal pressure is initially increased for the introduction of access devices.\textsuperscript{27-30} In young and healthy patients (ASA I and II) the hemodynamic and circulatory effects of a 15 mmHg pneumoperitoneum are generally not clinically relevant. Care has too be taken when establishing the pneumoperitoneum in the elderly and patients with severe co-morbidity (ASA III and IV).\textsuperscript{27,29-31} Invasive measurement of blood pressure or circulating volume should be considered. These patients should also receive adequate preoperative volume loading and beta-blockers.\textsuperscript{27,32,33} If technically feasible, gasless or low pressure laparoscopy might be an alternative for patients with limited cardiac function.\textsuperscript{27-29}

Incidence

Entry-related injuries mostly involve bowel and blood vessel injuries. The reported incidence of vascular and bowel injuries varies and is between 0.05 and 0.5 complications per 100 laparoscopic procedures.\textsuperscript{9,34-36} This is most likely an under-estimation as in the majority of cases, most injuries are not reported. The result of major vascular and unrecognized bowel injuries is serious, often leading to severe morbidity and even mortality. The overall mortality rate is reported to be about 4%, increasing to 21% for unrecognized bowel injury.\textsuperscript{34,36-40} The incidence of clinically relevant gas embolism is very rare (0.002-0.02%), but if it occurs it can be a fatal complication.\textsuperscript{27,41} Gas embolism usually occurs during the installation of the pneumoperitoneum using the Veress needle or less frequently a sharp trocar. The usual cause of gas embolism is the accidental placement of a needle or trocar into a blood vessel. Similarly, any injury to veins or parenchymal organs can result in direct gas inflow into the systemic circulation, especially during liver surgery.\textsuperscript{27} The incidence of extraperitoneal insufflation is between approximately 0.4 and 3.5%. Extensive preperitoneal insufflation can result in an altered outline of the abdominal cavity which can severely hamper the exposure of the laparoscopic procedure. Furthermore, extensive preperitoneal insufflation can result in serious complications such as a pneumothorax, pneumomediastinum, or pneumopericardium.\textsuperscript{27}
Complications during open and blind-entries

Historically, gynaecologists have been trained in the blind-entry technique with the Veress needle. Although the technique of open-laparoscopy was first described by the gynaecologist Hasson in 1971, only a few gynaecologists apply the open-entry technique. Some have reported comparable or even higher complication rates when applying the open-entry technique in gynaecological case series. However, in these studies the participating gynaecologists did not frequently use the open-entry technique and if used, this was mainly in selected patients who had prior abdominal surgery. Consequently, these patients already were at a higher risk for entry related complications. This explains why in a systematic review by Merlin et al. the risk of major complications initially appeared to be higher for the open-entry technique. When only prospective series were taken into account the opposite was shown; a relative risk of 0.30 (95% CI 0.09-1.03) was found in favour of the open-entry technique. It was noted that retrospective studies compared a high-risk with a low-risk patient population, while the prospective studies investigated an unselected patient population.

Recently, a review was performed concerning entry-related complications which included all malpractice claims filed at the largest medical liability mutual insurance company for hospitals in health care in the Netherlands. From January 1993 to December 2005, 229 laparoscopy-related claims were filed of which 41 (18%) claims were identified as entry-related complications. Most were young (median age 35 years) female patients who had routine, non-advanced laparoscopic procedures planned as short-stay or day-care procedures. In these patients, a total of 51 structures were injured. There were 18 vascular structure injuries, mainly retroperitoneal arteries. Furthermore, there were 30 bowel injuries, in two patients the uterus was injured and one injury involved extensive preperitoneal insufflation. An open-entry technique was used in only two (5%) of the 41 included patients. Both patients had a history of previous abdominal surgery and the injured structure was bowel. In the remainder, a blind (Veress) entry technique had been applied. Vascular injury was exclusively associated with the blind-entry technique. In only 19 (46%) patients the entry-related complication was diagnosed peroperatively. In the remaining patients, the entry-related injury was diagnosed postoperatively, median on day two (range 0-5).

In a recent survey of the U.S. Food and Drug Administration (FDA) by Fuller et al. reviewing all reports in a period from January 1997 to June 2002, 31 fatal and 1353 nonfatal trocar injuries were identified. Most fatalities involved vascular injuries. It was remarkable that almost all the vascular injuries were caused with the Veress needle or trocar during blind-entries. Bowel injury was reported in both the blind and open-entries. Furthermore, many injuries were caused by disposable shielded trocars and optical trocars. Although, the exact perspective concerning these FDA data is unclear because it is unknown how many open and blind-entries are being performed and how many shielded and optical trocars are used, it could carefully be concluded that neither shielded nor optical trocars can guarantee a safe installation of the pneumoperitoneum. Furthermore, retroperitoneal vascular injury seems to be associated with the blind-entry technique due to an “overshoot” of the introduction of the Veress needle or trocar. This injury mechanism is not present...
with the open-entry technique. However, an open-entry does not preclude bowel injury, just as a formal laparotomy could be complicated by bowel injury.

**Discussion**

The European Association for Endoscopic Surgery (E.A.E.S; www.eaes-eur.org) practical clinical guideline on the pneumoperitoneum does not state which of the entry techniques is the preferred one. In literature, it is suggested that the open-entry technique is the most safe entry technique because an overshoot of the introduction, especially those resulting in retroperitoneal vascular injury, can be avoided. However, an open-entry does not preclude bowel injury. Hashizume et al. reported in a retrospective study (1991-1995) that during the study period 96.6% of the Japanese surgeons changed their method of establishing a pneumoperitoneum from the closed technique to the open technique in order to increase patient safety. The rate of complications related to needle and/or trocar insertion subsequently decreased as the surgeon’s experience performing laparoscopic surgery using the open-entry technique increased. In patients without abdominal surgery in their history, an entry with the reusable TrocDoc® trocar (“half open”) might be an effective and less expensive alternative for the open-introduction according to Hasson. With respect to obese patients the open-entry technique can be technically difficult. For these patients, the blind-entry technique with the Veress needle remains a good alternative. The presence of peritonitis is not an absolute contra-indication for a laparoscopic approach. However, distended bowel poses a risk for bowel injury during the installation of the pneumoperitoneum. Therefore, a well controlled open-entry is in those circumstances the safest option.

In children and relatively thin adult patients the distance between the abdominal wall and retroperitoneal structures is reduced. Therefore, in those patients the open-entry technique might be the safest. Also, in pregnant females and in patients with ascites an open-entry is preferred. Nevertheless, identification of patients who have an increased risk of an entry-related injury is essential to prevent such injuries. Prior abdominal surgery, especially midline laparotomy, is associated with a considerable increased risk of adhesions of bowel with the anterior abdominal wall. After a Pfannenstiel incision in 31% of the patients adhesions are present and in 10% of the patients these adhesions are extensive. After a midline laparotomy, this is 51% and 30% respectively. Furthermore, a history of inflammatory bowel disease, peritonitis, and radiotherapy is associated with intra-abdominal adhesions and anatomical changes.

During physical examination it is important to search for abdominal wall herniations to prevent that the installation of the pneumoperitoneum is performed at these sites. Furthermore, the abdomen should be palpated to exclude organomegaly.

In conclusion, the installation of the pneumoperitoneum is exclusively associated with the laparoscopic approach and remains a potentially dangerous first step. Moreover,
approximately one half of all intra-operative laparoscopic complications are caused during the establishment of the pneumoperitoneum and introduction of the trocars. Although the incidence of entry-related injuries is very low for both the open and blind-entry techniques, retroperitoneal vascular injury (“overshoot of the introduction”) might be prevented by the open-entry technique. Based on available and reviewed literature, the open-entry technique seems to be the most safe entry technique and is to be preferred in most cases.

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